TURBINE EXHAUST CASE DESIGN

DESCRIPTION

1. Technical Field

This invention relates to axial flow gas turbine engines and, more particularly, to the support of turbine exit guide vanes.

2. Background Art

It is known in the gas turbine engine art to cantilever support turbine exit guide vanes by suitable rigid attachment of their outer ends to the outer turbine exhaust case. All axial, radial, and torsional vane loads are thereby transmitted into the outer exhaust case at the point of attachment of the vanes.

Pratt & Whitney Aircraft Group's F100 axial flow gas turbine engine has a turbine exhaust case assembly comprising inner and outer exhaust cases spaced apart by a plurality of radially extending hollow struts fixedly attached at both their inner and outer ends to said inner and outer exhaust cases, respectively. The outer exhaust case defines the radially outer surface of the engine gas flow path downstream of the last stage of turbine blades. The radially inner surface of the gas flow path is formed by a sheet metal, non-structural fairing spaced radially between the inner and outer cases and through which the struts pass, and which is cantilever supported at its rearward end from the inner case. The inner case is attached at its forward end to bearing support structure for the engine rotor shaft; and tie rods connected to the bearing support structure pass radially outwardly through the struts to an engine mount ring surrounding the outer case to transmit loads from the bearing support structure to the mount ring. In this F100 engine the sheet metal fairing only defines the inner flow path wall and acts as a heat shield to the inner case means and bearing support structure. There are no turbine exhaust guide vanes between the last turbine stage and the hollow struts.

DISCLOSURE OF INVENTION

One object of the present invention is a turbine exhaust case assembly with improved means for supporting a stage of turbine exit guide vanes.

According to one aspect of the present invention, a sheet metal fairing defines the inner wall of a turbine exhaust gas flow path and is cantilever supported from its rearward end from a radially inwardly spaced turbine case which is connected to a radially outerwardly spaced turbine case by a plurality of hollow, radially extending struts which pass through the fairing, wherein a stage of turbine exit guide vanes disposed immediately upstream of the struts extend across the gas flow path and have inner ends which are axially supported by the upstream end of the fairing and outer ends which are attached to the outer turbine exhaust case.

According to a preferred embodiment of the present invention, the outer ends of the vanes are pivotally mounted to the outer exhaust case to permit a small amount of rocking of the vanes in the upstream and downstream direction about the attachment point; and the inner ends of the vanes engage the gas path fairing in a manner permitting both radial and some axial movement of the inner ends of the vanes relative to the fairing.

This construction permits considerable distortion of the outer turbine exhaust case relative to the inner turbine exhaust case without inducing radial loads or excessive torsional loads in the sheet metal fairing, which is not a very strong structural member and would not normally be considered suitable as a vane support. Permitting the vanes to rock or pivot about their outer attachment points reduces the moments which would otherwise be transmitted from the outer case to the vanes and result in excessive axial motion at the inner ends of the vanes. Excessive axial motion at the inner ends of the vanes could result in interference between the vanes and those parts of the engine immediately upstream and downstream thereof, or, in the alternative, would require the fairing to be able to withstand much greater axial loads to prevent such movement.

The foregoing and other objects, features and advantages of the present invention will become more apparent in the light of the following detailed description of the preferred embodiments thereof as shown in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a cross-sectional elevation view of the turbine exhaust portion of an axial flow gas turbine engine constructed in accordance with the teachings of the present invention.

FIG. **2** is a cross-sectional view taken along the line **2—2** of FIG. **1**.

FIG. **3** is a cross-sectional view taken along the line **3—3** of FIG. **1**.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring to FIG. **1**, the turbine and turbine exhaust section of an axial flow gas turbine engine is shown in cross section. The portion shown comprises a turbine rotor assembly **10**, a turbine exhaust case assembly **12**, a rotor shaft **14**, a rear bearing **16**, bearing support structure **18**, tie rods **20**, and engine mount structure **22**.

The rotor assembly **10** is supported from the shaft **14** by means which are not shown but which are well known to those skilled in the art and which do not form a part of the present invention. The rotor assembly **10** includes a hub portion **24** having a plurality of turbine blades **26** extending radially outwardly therefrom across the gas flow path **28**.

The bearing **16** comprises a rotating outer race **27** and a stationary inner race **30** separated by circumferentially disposed roller elements **32**. The outer race **27** is secured to the rearward end **34** of the shaft **14** and rotates therewith. The stationary inner bearing race **30** is secured by suitable means to the bearing support structure **18** which comprises a plurality of annular structural members such as the "W" shaped support **36** and the shaft seal support **38**, which are secured together by bolts **40**. The construction of the bearing **16** and bearing support structure **18** are not critical to the present invention.

The turbine exhaust case assembly **12** comprises an inner case **42**, an outer case **44**, an annular fairing **46**, a plurality of radially extending hollow struts **48**, and a stage of turbine exit guide vanes **50**. In this embodiment there are six struts equally spaced circumferentially about the engine axis and fixedly attached at both their inner ends **52** and outer ends **54** to the inner and outer cases **42**, **44**, respectively. The upstream end **43** of the inner case **42** includes a radially inwardly extending flange **56** which is bolted to a corresponding outwardly extending flange **58** which is a part of the shaft seal support **38**. It can thus be seen that the turbine exhaust